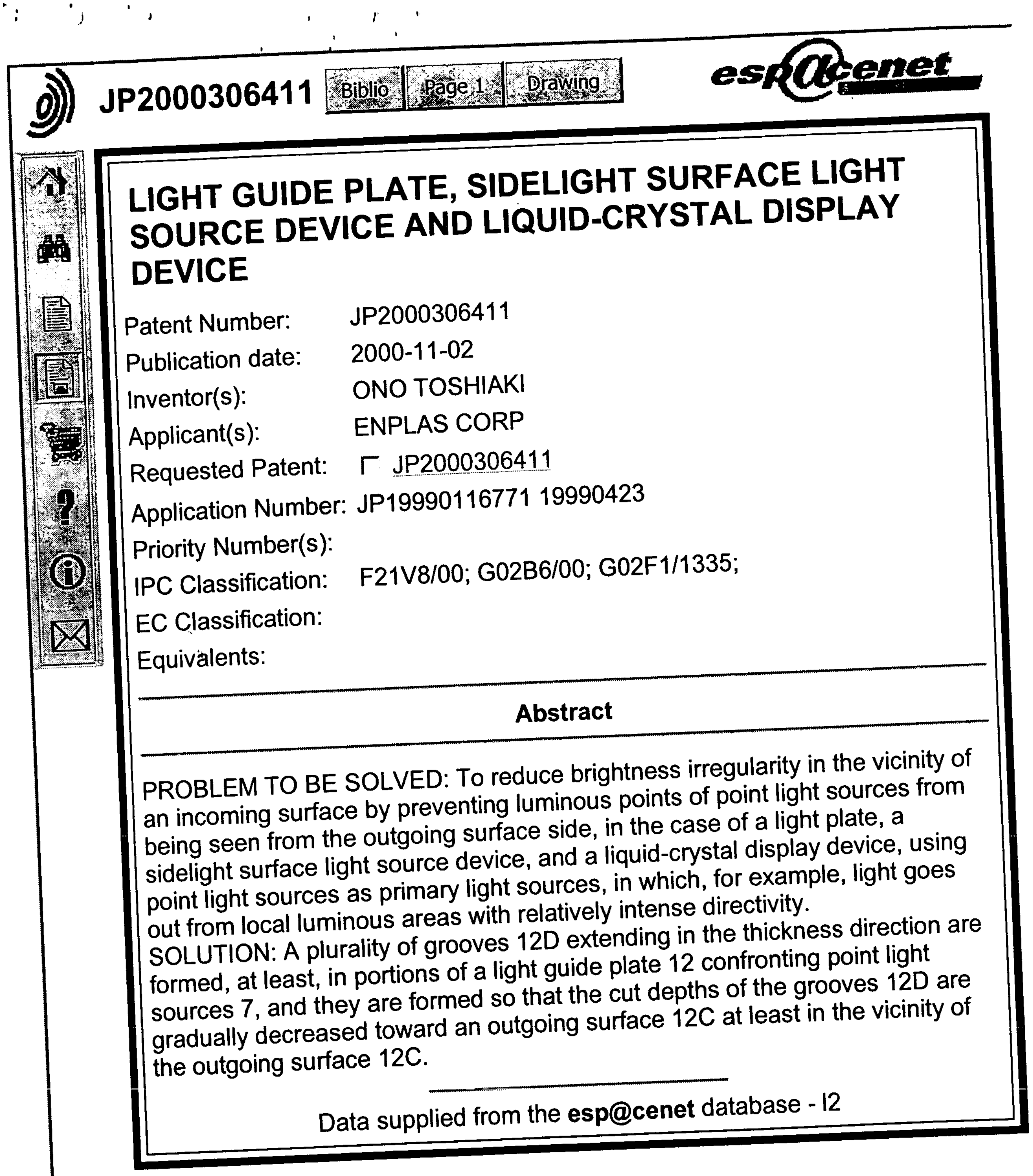

JP2000306411

# LIGHT GUIDE PLATE, SIDELIGHT SURFACE LIGHT SOURCE DEVICE AND LIQUID-CRYSTAL DISPLAY DEVICE

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## Abstract

PROBLEM TO BE SOLVED: To reduce brightness irregularity in the vicinity of an incoming surface by preventing luminous points of point light sources from being seen from the outgoing surface side, in the case of a light plate, a sidelight surface light source device, and a liquid-crystal display device, using point light sources as primary light sources, in which, for example, light goes out from local luminous areas with relatively intense directivity.
SOLUTION: A plurality of grooves 12D extending in the thickness direction are formed, at least, in portions of a light guide plate 12 confronting point light sources 7, and they are formed so that the cut depths of the grooves 12D are gradually decreased toward an outgoing surface 12C at least in the vicinity of the outgoing surface 12C.

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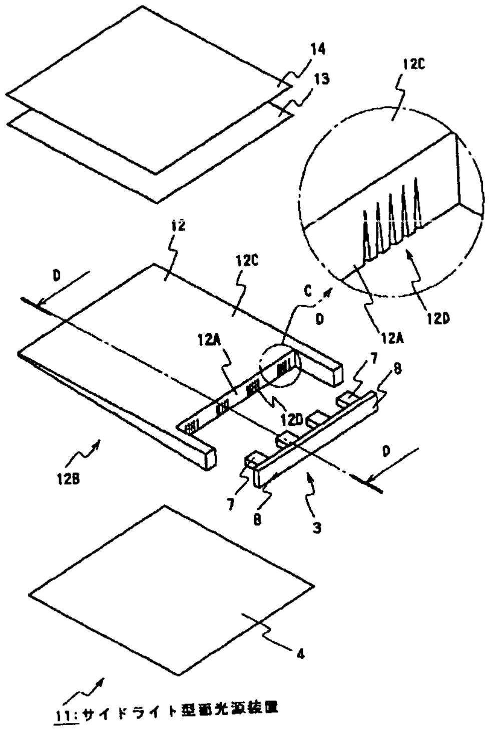
(54)【発明の名称】 導光板、サイドライト型面光源装置及び液晶表示装置

(57)【要約】

【課題】 本発明は、導光板、サイドライト型面光源装置及び液晶表示装置に関し、例えば局所的な発光領域から比較的強い指向性を以て光が出射する点光源を一次光源にしてなる場合に適用して、点光源の発光点を出射面側より目視できないようにして入射面近傍の輝度ムラを低減する。

【解決手段】 少なくとも導光板１２の点光源７に対向する部位に、厚さ方向に延長する複数の溝１２Ｄを形成し、少なくとも出射面１２Ｃ近傍においては、この溝１２Ｄの彫り込み深さが出射面１２Ｃに近づくに従って徐々に浅くなるように形成する。



【特許請求の範囲】

【請求項１】点光源から出射した照明光を端面から入射し、前記照明光を屈曲して出射面より出射する導光板において、

少なくとも前記端面の前記点光源に対向する部位に、厚さ方向に延長する複数の溝を形成し、

少なくとも前記出射面近傍において、前記出射面に近づくに従って徐々に彫り込み深さが浅くなるように前記溝を形成したことを特徴とする導光板。

【請求項２】前記出射面と対向する面側で彫り込み深さが最も深くなるように、前記溝を形成したことを特徴とする請求項１又は請求項２に記載の導光板。

【請求項３】請求項１又は請求項２に記載の導光板を用いたことを特徴とするサイドライト型面光源装置。

【請求項４】請求項３に記載のサイドライト型面光源装置により液晶表示パネルを照明することを特徴とする液晶表示装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、導光板、サイドライト型面光源装置及び液晶表示装置に関し、例えば局所的な発光領域から比較的強い指向性を以て光が出射する点光源を一次光源にしてなる場合に適用することができる。本発明は、少なくとも導光板の点光源に対向する部位に、厚さ方向に延長する複数の溝を形成し、少なくとも出射面近傍においては、この溝の彫り込み深さが出射面に近づくに従って徐々に浅くなるようにすることにより、点光源の発光点を出射面側より目視できないようにして入射面近傍の輝度ムラを低減する。

【０００２】

【従来の技術】従来、例えば液晶表示装置は、サイドライト型面光源装置により液晶表示パネルを照明するようになされている。

【０００３】図6は、点光源により一次光源を構成したサイドライト型面光源装置１の一例を示す分解斜視図であり、図7は、図６をＡ－Ａ線で切り取って示す断面図である。このサイドライト型面光源装置１は、導光板２の側方に一次光源３を配置し、反射シート４、導光板２を順次積層して形成される。なおサイドライト型面光源装置１は、導光板２の出射面２Ｃ上に、出射光の特性を補正する各種シート材が必要に応じて適宜配置される。

【０００４】一次光源３は、例えば矩形形状の樹脂パッケージに半導体チップが封止された局所的な発光領域から比較的強い指向性を以て光が出射する点光源７をプリント基板等の保持部材８に搭載して形成され、これら点光源７より出射される照明光を導光板２の入射面２Ａに入射する。

【０００５】導光板２は、例えば透明部材でなるアクリル（ＰＭＭＡ樹脂）を射出成形して断面楔型形状に形成され、入射面２Ａより一次光源３の照明光を入射する。これにより導光板２は、反射シート４側平面（以下裏面と呼ぶ）２Ｂと出射面２Ｃとの間を繰り返し反射して照明光を伝搬し、この裏面２Ｂ及び出射面２Ｃにおける反射の際に、臨界角以下の成分を裏面２Ｂ及び出射面２Ｃより出射する。

【０００６】反射シート４は、金属箔等でなるシート状の正反射部材、又は白色ＰＥＴフィルム等でなるシート状の乱反射部材により形成され、導光板２の裏面２Ｂより漏れ出す照明光を反射して導光板２に再入射させ、これにより照明光の利用効率を向上させる。

【０００７】このような照明光の出射原理に係るサイドライト型面光源装置１において、導光板２は、点光源７と対向する部位に凹部２Ｄが形成される。

【０００８】すなわち導光板２の入射面２Ａを平坦な面により作成した場合、サイドライト型面光源装置１においては、点光源７より出射される照明光の指向性により、符号Ｅにより示すように、入射面近傍の点光源７間、出射面２Ｃの入射面側隅部において出射光量が低下し、これにより入射面近傍で輝度ムラが発生する。

【０００９】図6において符号Ｂにより部分的に拡大して示すように、凹部２Ｄは、導光板２の厚さ方向にほぼ一様な断面略円弧形状に形成され、この円弧形状の曲面が凹レンズのレンズ面として機能する。これにより導光板２は、出射面２Ｃと平行な面内において、点光源７の正面方向に集中して出射される照明光Ｌの指向性を補正し、点光源７間、出射面２Ｃの隅部に照明光を振り分ける。

【００１０】これによりこの種の点光源によるサイドライト型面光源装置１においては、入射面近傍の輝度ムラを低減するようになされている。

【００１１】

【発明が解決しようとする課題】ところでこのように点光源７と対向する部位に凹部２Ｄを形成すると、サイドライト型面光源装置１においては、図7において符号Ｃにより示すように、この凹部２Ｄを介して点光源７より出射される照明光が出射面２Ｃ側に直接出射されることになる。

【００１２】これにより液晶表示装置においては、輝度ムラを防止できても、点光源の発光点が出射面側より目視され、表示画面の品位が著しく劣化する問題がある。

【００１３】本発明は以上の点を考慮してなされたもので、点光源の発光点を出射面側より目視できないようにして入射面近傍の輝度ムラを低減することができる導光板、この導光板を用いたサイドライト型面光源装置及び液晶表示装置を提案しようとするものである。

【００１４】

【課題を解決するための手段】かかる課題を解決するため請求項１に係る発明においては、点光源から出射した照明光を端面から入射し、照明光を屈曲して出射面より出射する導光板において、少なくとも端面の点光源に対

向する部位に、厚さ方向に延長する複数の溝を形成し、少なくとも出射面近傍において、出射面に近づくに従って徐々に彫り込み深さが浅くなるようにこの溝を形成する。

【0015】また請求項2に係る発明においては、出射面と対向する面側で彫り込み深さが最も深くなるように溝を形成する。

【0016】また請求項3に係る発明においては、請求項1又は請求項2に記載の導光板を用いてサイドライト型面光源装置を構成する。

【0017】また請求項4に係る発明においては、請求項3に記載のサイドライト型面光源装置により液晶表示パネルを照明して液晶表示装置を形成する。

【0018】請求項1に係る構成によれば、点光源から出射した照明光を端面から入射し、照明光を屈曲して出射面より出射する導光板において、少なくとも端面の点光源に対向する部位に、厚さ方向に延長する複数の溝を形成し、少なくとも出射面近傍において、出射面に近づくに従って徐々に彫り込み深さが浅くなるように溝を形成することにより、複数の溝により出射面近傍の輝度ムラを低減し、かつ発光点から出射された照明光の出射面側への直接の出射を防止することができる。

【0019】また請求項2に係る構成によれば、出射面と対向する面側で彫り込み深さが最も深くなるように溝を形成することにより、簡易な構成で、点光源の発光点を出射面側より目視できないようにして出射面近傍の輝度ムラを低減することができる。

【0020】また請求項3に係る構成によれば、請求項1又は請求項2に記載の導光板を用いてサイドライト型面光源装置を構成することにより、入射面近傍についても出射面を有効に使用して面光源装置を構成することができる。

【0021】また請求項4に係る構成によれば、請求項3に記載のサイドライト型面光源装置により液晶表示パネルを照明して液晶表示装置を形成すれば、面光源装置の入射面近傍についても出射面を有効に使用して液晶表示装置を構成して、高品位の表示画像を表示することができる。

【0022】

【発明の実施の形態】以下、適宜図面を参照しながら本発明の実施の形態を詳述する。

【0023】（1）実施の形態の構成

図1は、本発明の実施の形態に適用されるサイドライト型面光源装置を示す分解斜視図である。この実施の形態に係る液晶表示装置では、このサイドライト型面光源装置11により液晶表示パネルを照明する。なおこの図1に示す構成において、図6について上述したサイドライト型面光源装置1と同一の構成は、対応する符号を付して示し、重複した説明は省略する。

【0024】このサイドライト型面光源装置11においては、導光板12の裏面12B側に反射シート4を配置し、さらに出射面12C上にプリズムシート13及び14を積層して形成される。

【0025】ここで導光板12は、透明部材でなる例えばアクリル（PMMA樹脂）を射出成形して断面楔型形状に形成され、入射面12Aより一次光源3の照明光を入射する。これにより導光板12は、裏面12Bと出射面12Cとの間を繰り返し反射して照明光を伝搬し、この裏面12B及び出射面12Cにおける反射の際に、臨界角以下の成分を裏面12B及び出射面12Cより出射する。

【0026】さらにこの導光板12は、裏面12Bを局所的に粗面にして照明光の出射を促す光散乱パターンが形成される。ここで光散乱パターンは、例えばマット面処理、対応する金型へのエッチングによる加工処理や放電加工等の適当な粗面化処理により、出射面を部分的に円形形状に粗面化して形成される。また光散乱パターンは、出射面側より見て知覚困難な小径により形成される。

【0027】これら光散乱パターンは、裏面12Bを鏡面により形成した場合に出射光量が低下する部分においては、この光量の低下に対応するように単位面積当たりの個数が増大するように形成され、これにより出射面12Cより出射される照明光の出射光量を均一化するようになされている。なおこの実施の形態において、光散乱パターンは、入射面12A側より楔型先端に向かって徐々に単位面積当たりの個数が増大するように、さらに入射面12Aの近傍の入射面12Aに沿った方向については、点光源7間、出射面12Cの隅部に向かって徐々に単位面積当たりの個数が増大するように、また不規則に配置される。なお光散乱パターンは、円形形状に限らず、矩形形状等の他の形状であっても良い。また粗さの程度を変えて裏面12Bの全面を粗面化することによっても、出射面12Cより出射される照明光の出射光量を均一化することもできる。

【0028】このようにして照明光を出射する導光板12は、矢印Cにより部分的に拡大して示すように、入射面12Aに同一形状の溝12Dが繰り返し形成されるようになされている。ここでこれらの溝12Dは、点光源7と対向する部位に、入射面12Aの厚さ方向に延長するように形成される。

【0029】さらに溝12Dは、出射面12Cと平行な面により断面を取って図2に示すように、入射面12Aに対して斜めに傾いた1対の平面による斜面を接続して形成され、これにより導光板12は、点光源7の正面方向に集中して出射される照明光Lの指向性を補正し、この面内方向については広がるように照明光を入射する。

【0030】さらに溝12Dは、裏面12Bより出射面12Cに近づくに従って徐々に彫り込み深さが浅くなり、出射面12Cの近傍では途絶えるように形成され

る。ここでこの実施の形態において、溝１２Ｄは、出射面１２Ｃに近づくに従って単調に彫り込み深さが低下するように形成される。これにより図１をＤ－Ｄ線により切り取って図３に示すように、導光板１２は、出射面１２Ｃ側に向けて点光源７より出射される照明光を入射面１２Ａで遮り、点光源である点光源７の発光点が出射面１２Ｃ側より目視されないようにする。

【００３１】プリズムシート１３は、導光板１２の出射面１２Ｃとは逆側の面に光制御面であるプリズム面が形成される。ここでプリズム面は、導光板１２の入射面１２Ａとほぼ平行に延長する１対の斜面による突起が入射面１２Ａ側より楔型先端に向かって繰り返されて形成され、この１対の斜面により導光板１２から出射される照明光の指向性を出射面１２Ｃの正面方向に補正する。

【００３２】続くプリズムシート１４は、導光板１２の出射面１２Ｃとは逆側の面に、プリズムシート１３と同様の突起がプリズムシート１３の突起の延長方向とほぼ直交する方向に延長するように繰り返し形成される。これによりプリズムシート１４は、プリズムシート１３より出射される照明光の指向性を出射面１２Ｃの正面方向に強調して射出する。

【００３３】（２）実施の形態の動作

以上の構成において、点光源７から射出された照明光は（図１）、入射面１２Ａより導光板１２の内部に入射し、この照明光が裏面１２Ｂと出射面１２Ｃとの間で反射を繰り返しながら、導光板１２の内部を伝搬する。このときこの照明光は、裏面１２Ｂで反射する毎に、出射面１２Ｃに対する入射角が低下し、出射面１２Ｃに対して臨界角以下で入射する成分が出射面１２Ｃより出射される。また照明光は、裏面１２Ｂで反射する際に、この裏面１２Ｂに形成された光拡散パターンにより散乱され、その結果裏面１２Ｂを平坦な面により作成した場合に出射光量の減少する部分で出射が促され、ほぼ均一な光量分布により出射面１２Ｃより出射される。

【００３４】このようにして点光源７より導光板１２に照明光を入射するにつき、点光源７より出射される照明光は（図２）、点光源７の正面方向に向けて鋭い指向性により出射されることにより、その分入射面１２Ａを平坦な面により作成したのでは、入射面１２Ａ近傍の点光源７間、出射面１２Ｃの入射面側隅部で出射光量が低下し、輝度ムラが観察される。

【００３５】これに対してこの実施の形態においては、入射面１２Ａに形成された溝１２Ｄにおいて、この溝１２Ｄを形成する斜面に入射する照明光Ｌが、それぞれ斜面により光路が折り曲げられ、導光板１２の両側面に振り分けられる（図２）。これにより導光板１２では、点光源７間、入射面側隅部で不足する照明光Ｌの光量が補われて、出射光の輝度ムラが低減される。

【００３６】さらにこのようにして照明光Ｌを振り分けるにつき、導光板１２では（図３）、出射面１２Ｃに近づくに従って徐々に溝１２Ｄの彫り込み深さが浅くなり、出射面１２Ｃの近傍では溝１２Ｄが途絶えていることにより、点光源７より出射して出射面１２Ｃ側に向かう照明光は、入射面１２Ａにより遮られる。これにより点光源の発光点を出射面側より目視できないようにすることができ、その分液晶表示装置として高品位の表示画像を形成することができる。

【００３７】（３）実施の形態の効果

以上の構成によれば、少なくとも導光板１２の点光源７に対向する部位に、厚さ方向に延長する複数の溝１２Ｄを形成し、少なくとも出射面１２Ｃ近傍においては、この溝１２Ｄの彫り込み深さが出射面１２Ｃに近づくに従って徐々に浅くなるようにすることにより、点光源７の発光点を出射面１２Ｃ側より目視できないようにして入射面１２Ａ近傍の輝度ムラを低減することができる。

【００３８】従ってサイドライト型面光源装置１１においては、入射面１２Ａの近傍については、導光板の出射面に何ら遮光等の処理を講じることなく液晶表示パネル等の照明に利用することができ、その分入射面近傍についても出射面を有効に使用することができる。また液晶表示装置としては、面光源装置の入射面近傍についても出射面を有効に使用して液晶表示装置を構成でき、また高品位の表示画像を表示することができる。

【００３９】（４）他の実施の形態

なお上述の実施の形態においては、出射面１２Ｃに近づくに従って単調に彫り込み深さを浅くする場合について述べたが、本発明はこれに限らず、図４に示すように、出射面に近づくに従って２次関数的に彫り込み深さを浅くする場合等、要は出射面に近づくに従って徐々に彫り込み深さを浅くして上述の実施の形態と同様の効果を得ることができる。

【００４０】また上述の実施の形態においては、裏面側で最も彫り込み深さが深くなるように溝を形成する場合について述べたが、本発明はこれに限らず、図５に示すように、入射面１２Ａのほぼ中央で溝の深さが最も深くなるように形成する場合等、要は少なくとも出射面近傍において、出射面に近づくに従って徐々に彫り込み深さが浅くなるように溝を形成して上述の実施の形態と同様の効果を得ることができる。

【００４１】また上述の実施の形態においては、点光源と対向する部位についてだけ溝を形成する場合について述べたが、本発明はこれに限らず、要は少なくとも点光源と対向する部位に溝を形成すれば上述の実施の形態と同様の効果を得ることができ、例えば入射面の全面に溝を形成してもよい。

【００４２】また上述の実施の形態においては、入射面１２Ａに対して斜めに傾いた１対の平面による斜面を接続して溝を形成する場合について述べたが、本発明はこれに限らず、曲面により溝を形成してもよい。なお曲面により溝を形成する場合には、単に上述の実施の形態に

係る溝の斜面を曲面に置き換える場合だけでなく、出射面と平行な面により断面を取って見たとき、例えば入射面の断面が正弦波形状により変化するように形成する場合等も考えられる。

【0043】また上述の実施の形態においては、単に入射面に溝を形成する場合について述べたが、本発明はこれに限らず、例えばマット面処理、インクの付着等による粗面化処理により、溝を形成した入射面を光拡散面としてもよい。このようにすれば、さらに一段と効率良く照明光を両側面に振り分けることができる。

【0044】さらに上述の実施の形態においては、矩形形状の樹脂パッケージに半導体チップが封止された点光源を使用する場合について述べたが、本発明はこれに限らず、種々の形状の点光源を使用する場合に広く適用することができる。なおこれらの点光源としては、樹脂パッケージに封止することなく半導体チップを直接基板表面に実装して構成されるもの等があり、この場合には半導体チップを保護被膜などで必要に応じて被覆する場合もある。

【0045】さらに上述の実施の形態では、一端面より照明光を入射する場合について述べたが、本発明はこれに限らず、併せて他の端面から照明光を入射する構成のサイドライト型面光源装置にも広く適用することができる。

【0046】さらに上述の実施の形態では、断面楔型形状の板状部材でなる導光板を用いたサイドライト型面光源装置に本発明を適用する場合について述べたが、本発明はこれに限らず、平板形状の導光板を用いたサイドライト型面光源装置にも広く適用することができる。

【0047】また上述の実施の形態では、導光板の出射面にプリズムシートを積層して配置する場合について述べたが、本発明はこれに限らず、照明光を拡散させる光拡散シートを配置する場合等、種々のシート材を配置する場合に広く適用することができ、また特に必要がなければ、これらのシート材を省略することもできる。

【0048】さらに上述の実施の形態では、液晶表示装置の面光源装置に本発明を適用した場合について述べたが、本発明はこれに限らず、種々の照明機器、表示装置等のサイドライト型面光源装置、さらにはこのサイドライト型面光源装置の導光板に広く適用することができる。

【0049】

【発明の効果】上述のように本発明によれば、少なくとも導光板の点光源に対向する部位に、厚さ方向に延長する複数の溝を形成し、少なくとも出射面近傍においては、この溝の彫り込み深さが出射面に近づくに従って徐々に浅くなるようにすることにより、点光源の発光点を出射面側より目視できないようにして入射面近傍の輝度ムラを低減することができる。

【図面の簡単な説明】

【図1】本発明の実施の形態に係るサイドライト型面光源装置を示す分解斜視図である。

【図2】図1の導光板における溝の動作の説明に供する断面図である。

【図3】図1をD－D線により切り取って示す断面図である。

【図4】図3との対比により他の実施の形態に係る導光板を示す断面図である。

【図5】図3との対比により、入射面の中央部分で最も深くなるように溝を形成した導光板を示す断面図である。

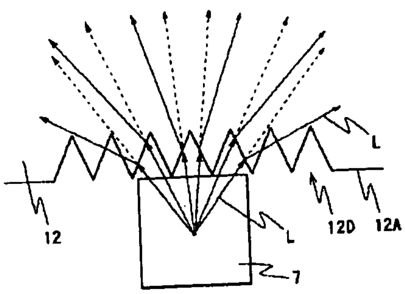
【図6】従来のサイドライト型面光源装置を示す分解斜視図である。

【図7】図6をA－A線により切り取って示す断面図である。

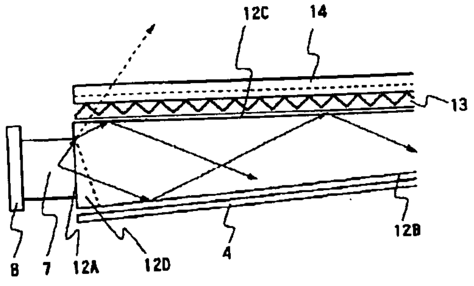
【符号の説明】

1、11……サイドライト型面光源装置、2、12……導光板、2A、12A……入射面、2B、12B……裏面、2C、12C……出射面、3……一次光源、4……反射シート、7……点光源、12D……溝

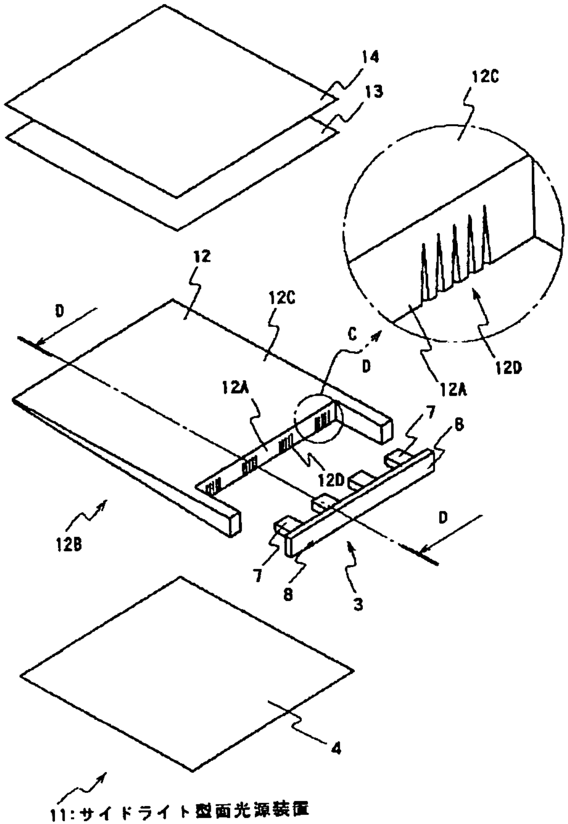
【図2】



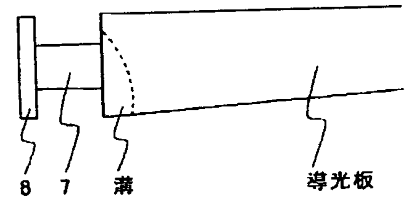
【図3】



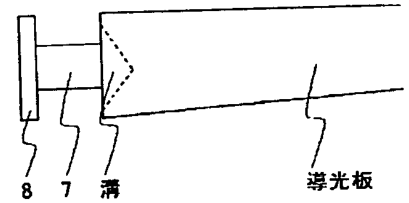
【図1】


D
C
D
D
11:サイドライト型面光源装置

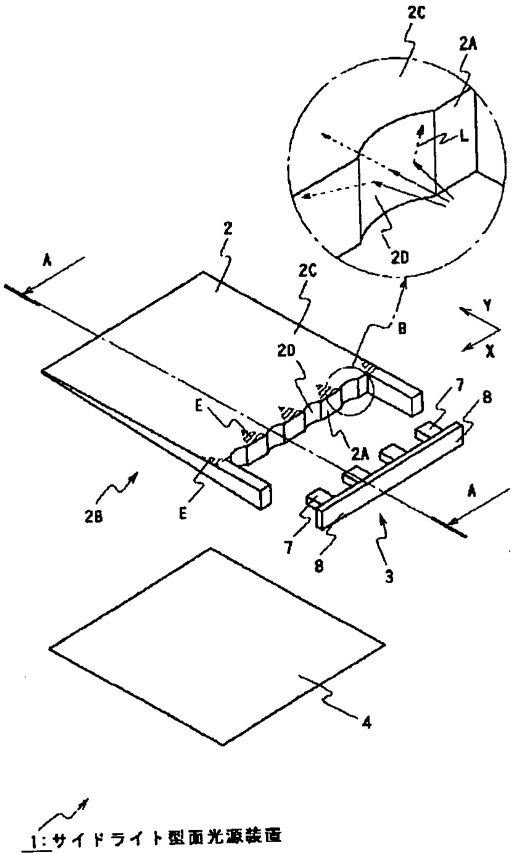
【図4】


8
7
溝
導光板

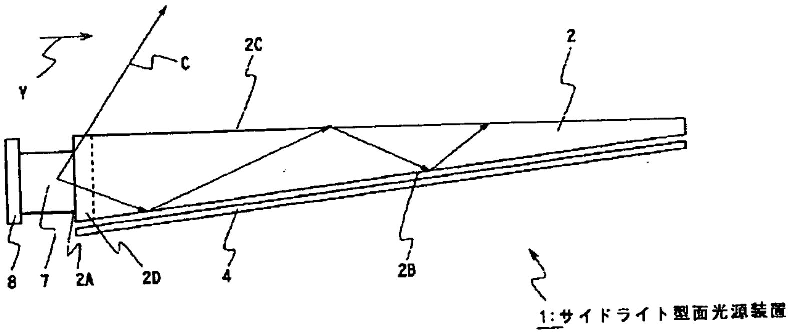
【図5】


8
7
溝
導光板

【図6】


2C
2A
L
2D
2
2C
B
Y
X
2D
A
E
2A
7
8
2B
E
A
7
8
3
4
1:サイドライト型面光源装置

【図7】


Y
C
2C
2
8
7
2A
2D
4
2B
1:サイドライト型面光源装置

12

# PATENT ABSTRACTS OF JAPAN

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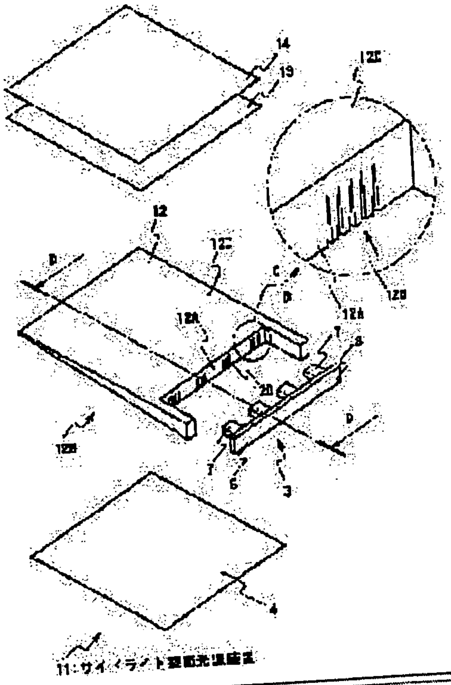
## (54) LIGHT GUIDE PLATE, SIDELIGHT SURFACE LIGHT SOURCE DEVICE AND LIQUID-CRYSTAL DISPLAY DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To reduce brightness irregularity in the vicinity of an incoming surface by preventing luminous points of point light sources from being seen from the outgoing surface side, in the case of a light plate, a sidelight surface light source device, and a liquid-crystal display device, using point light sources as primary light sources, in which, for example, light goes out from local luminous areas with relatively intense directivity.

SOLUTION: A plurality of grooves 12D extending in the thickness direction are formed, at least, in portions of a light guide plate 12 confronting point light sources 7, and they are formed so that the cut depths of the grooves 12D are gradually decreased toward an outgoing surface 12C at least in the vicinity of the outgoing surface 12C.



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LEGAL STATUS

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[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's

decision of rejection]
[Date of extinction of right]

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## CLAIMS

[Claim(s)]

[Claim 1]
In the light guide plate which carries out incidence of the lighting light which carried out outgoing radiation from the point light source from an end face, is crooked and carries out outgoing radiation of the aforementioned lighting light from an outgoing radiation side The light guide plate characterized by forming the aforementioned slot so that it may carve gradually and the lump depth may become shallow as two or more slots extended in the thickness direction are formed in the part which counters the aforementioned point light source of the aforementioned end face at least and it is approached [ near / aforementioned / the outgoing radiation side ] in the aforementioned outgoing radiation side at least.

[Claim 2]
The light guide plate according to claim 1 or 2 characterized by forming the aforementioned slot so that it may carve by the aforementioned outgoing radiation side and field side which counters and the lump depth may become the deepest.

[Claim 3]
Side light type surface light source equipment characterized by using a light guide plate according to claim 1 or 2.

[Claim 4]
The liquid crystal display characterized by illuminating a liquid crystal display panel with side light type surface light source equipment according to claim 3.

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## DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001] [The technical field to which invention belongs]
this invention -- a light guide plate, side light type surface light source equipment, and a liquid crystal display -- being related -- for example, directivity comparatively strong from a local luminescence field -- with, when light comes to make into the primary light source the point light source which carries out outgoing radiation, it can apply as the point emitting [ of the point light source ] light cannot be viewed from an outgoing radiation side side by [ by which this slot carves / near the outgoing radiation side / at least / form two or more slots extended in the thickness direction to the part to which this invention counters the point light source of a light guide plate at least, and ], and the lump depth approaches an outgoing radiation side / it being alike, following and making it become gradually shallow, the brightness nonuniformity near the plane of incidence is reduced

[0002] [Description of the Prior Art]
The former, for example, a liquid crystal display, is made as [ illuminate / a liquid crystal display panel / with side light type surface light source equipment ].

[0003] Drawing 6 is the decomposition persp ctive diagram showing an example of the side light typ surface light source equipment 1 which constituted the primary light source by the point light source, and drawing 7 is the cross section cutting off and showing drawing 6 by the A-A line. This side light type surface light source equipment 1 arranges the primary light source 3, carries out the laminating of the reflective sheet 4 and the light guide plate 2 to the side of a light guide plate 2 one by one, and is formed in it. In addition, as for side light type surface light source equipment 1, **** arrangement of the amendment various web materials is carried out on outgoing radiation side 2C of a light guide plate 2 if needed in the property of outgoing radiation light.

[0004] directivity with the primary light source 3 comparatively strong from the local luminescence field where the semiconductor chip was closed by the resin package of for example, a rectangle configuration -- with, light carries the point light source 7 which carries out outgoing radiation in the attachment components 8, such as a printed circuit board, and is formed, and incidence of the lighting light by which outgoing radiation is carried out from these point light sources 7 is carried out to plane-of-incidence 2A of a light guide plate 2

[0005] A light guide plate 2 carries out injection molding of the acrylic (PMMA resin) which becomes by the transparent member, is formed in a cross-section wedge-action-die configuration, and carries out incidence of the lighting light of the primary light source 3 from plane-of-incidence 2A. More nearly thereby than rear-face 2B and outgoing radiation side 2C, a light guide plate 2 repeats between reflective sheet 4 side flat-surface (it is called rear face below) 2B and outgoing radiation side 2C, reflects, spreads lighting light, and carries out outgoing radiation of the component below a critical angle in the case of the reflection in this rear-face 2B and outgoing radiation side 2C.

[0006] The reflective sheet 4 is formed of the irregular reflection member of the shape of a sheet which becomes with a mirror reflection member or a white PET film of the shape of a sheet which becomes by the metallic foil etc., and it reflects the lighting light which begins to leak from rear-face 2B of a light guide plate 2, it is made it to carry out re-incidence to a light guide plate 2, and, thereby, it raises the use efficiency of lighting light.

[0007] Crevice 2D is formed in the part which a light guide plate 2 counters with the point light source 7 in the side light type surface light source equipment 1 concerning the outgoing radiation principle of such a lighting light.

[0008] That is, in side light type surface light source equipment 1, when plane-of-incidence 2A of a light guide plate 2 is created according to a flat field, in the plane-of-incidence side corner of outgoing radiation side 2C, the outgoing radiation quantity of light falls between the point light sources 7 near the plane of incidence, and, thereby, brightness nonuniformity occurs near the plane of incidence with the directivity of the lighting light by which outgoing radiation is carried out from the point light source 7, so that Sign E may show.

[0009] As it expands partially with Sign B and drawing 6 is shown, crevice 2D is formed in the thickness direction of a light guide plate 2 at an almost uniform cross-section approximate circle arc configuration, and the curved surface of this radii configuration functions as a lens side of a concave lens. Thereby, a light guide plate 2 amends the directivity of the lighting light L by which concentrates and outgoing radiation is carried out in the direction of a transverse plane of the point light source 7 into a field parallel to outgoing radiation side 2C, and distributes lighting light to the corner of outgoing radiation side 2C between the point light sources 7.

[0010] Thereby in the side light type surface light source equipment 1 by this kind of point light source, it is made as [ reduce / the brightness nonuniformity near the plane of incidence ].

[0011] [Problem(s) to be Solved by the Invention]
By the way, in side light type surface light source equipment 1, when crevice 2D is formed in the point light source 7 and the part which counters in this way, as Sign C shows drawing 7 , outgoing radiation of the lighting light by which outgoing radiation is carried out from the point light source 7 through this crevice 2D will be directly carried out to the outgoing radiation side 2C side.

[0012] Thereby, even if it can prevent brightness nonuniformity in a liquid crystal display, the point of the point light source emitting light is viewed from an outgoing radiation side side, and there is a problem on which the grace of the display screen deteriorates remarkably.

[0013] this invention was made in consideration of the above point, and tends to propose the light guide plate which can reduce the brightness nonuniformity near the plane of incidence as cannot view the point of the point light source emitting light from an outgoing radiation side side, the side light type surface light source equipment using this light guide plate, and a liquid crystal display.

[0014] [Means for Solving the Problem]
In invention which relates to a claim 1 in order to solve this technical problem In the light guide plate which carries out incidence of the lighting light which carried out outgoing radiation from the point light source from an end face, is crooked and carries out outgoing radiation of the lighting light from an outgoing radiation side This slot is formed so that it may carve gradually and the lump depth may become shallow as two or more slots extended in the thickness direction are formed in the part which counters the point light source of an end face at least and it is approached [ near the outgoing radiation side ] in an outgoing radiation side at least.

[0015] Moreover, in invention concerning a claim 2, a slot is formed so that it may carve by the outgoing radiation side and field side which counters and the lump depth may become the deepest.

[0016] Moreover, in invention concerning a claim 3, side light type surface light source equipment is constituted using a light guide plate according to claim 1 or 2.

[0017] Moreover, in invention concerning a claim 4, a liquid crystal display panel is illuminated with side light type surface light source equipment according to claim 3, and a liquid crystal display is formed.

[0018] In the light guide plate which according to the composition concerning a claim 1 carries out incidence of the lighting light which carried out outgoing radiation from the point light source from an end face, is crooked and carries out outgoing radiation of the lighting light from an outgoing radiation side Form two or more slots extended in the thickness direction in the part which counters the point light source of an end face at least, and it sets near the outgoing radiation side at least. The direct outgoing radiation by the side of the outgoing radiation side of the lighting light by which reduced the brightness nonuniformity near the outgoing radiation side by two or more slots by forming a slot so that it might carve gradually and the lump depth might become shallow as the outgoing radiation side was approached, and outgoing radiation was carried out from the point emitting light can be prevented.

[0019] Moreover, according to the composition concerning a claim 2, by forming a slot so that it may carve by the outgoing radiation side and field side which counters and the lump depth may become the deepest, with simple composition, as the point of the point light source emitting light cannot be viewed from an outgoing radiation side side, the brightness nonuniformity near the outgoing radiation side can be reduced.

[0020] Moreover, according to the composition concerning a claim 3, surface light source equipment can be constituted also near the plane of incidence by constituting side light type surface light source equipment using a light guide plate according to claim 1 or 2, using an outgoing radiation side effectively.

[0021] Moreover, according to the composition concerning a claim 4, a liquid crystal display panel is illuminated with side light type surface light source equipment according to claim 3, if a liquid crystal display is formed, a liquid crystal display can be constituted also near the plane of incidence of surface light source equipment, using an outgoing radiation side effectively, and a high-definition display image can be displayed.

[0022] [Embodiments of the Invention]
Hereafter, the form of operation of this invention is explained in full detail, referring to a drawing suitably.

[0023] (1) The block diagram 1 of the form of operation is a decomposition perspective diagram showing the side light type surface light source equipment applied to the form of operation of this invention. In the liquid crystal display concerning the form of this operation, a liquid crystal display panel is illuminated with this side light type surface light source equipment 11. In addition, in the composition shown in this drawing 1 , the same composition as the side light type surface light source equipment 1 mentioned above about drawing 6 attaches a corresponding sign, it is shown and the duplicate explanation is omitted.

[0024] In this side light type surface light source equipment 11, the reflective sheet 4 is arranged to the rear-face 12B side of a light guide plate 12, and further, on outgoing radiation side 12C, the laminating of the prism sheets 13 and 14 is carried out, and it is formed.

[0025] More here than plane-of-incidence 12A, a light guide plate 12 carries out injection molding of the acrylic (PMMA resin) which becomes by the transparent member, is formed in a cross-section wedge-action-die configuration, and carries out incidence of the lighting light of the primary light source 3. More nearly thereby than rear-face 12B and outgoing radiation side 12C, a light guide plate 12 repeats between rear-face 12B and outgoing radiation side 12C, reflects, spreads lighting light, and carries out outgoing radiation of the component below a critical angle in the case of the reflection in this rear-face 12B and outgoing radiation side 12C.

[0026] Furthermore, the light-scattering pattern to which this light guide plate 12 makes rear-face 12B a split face locally, and the outgoing radiation of lighting light is urged is formed. Of suitable split-face-ized processing of a processing processing, an electron discharge method, etc. by etching to the metal mold which mat-side-processes and corresponds, for example, a light-scattering pattern split-face-izes an outgoing radiation side in a circular configuration partially, and is formed here. Moreover, a light-scattering pattern is seen from an outgoing radiation side side, and is formed of the minor diameter where consciousness is difficult.

[0027] In the portion to which the outgoing radiation quantity of light falls when rear-face 12B is formed by the mirror plane, these light-scattering pattern is formed so that it may correspond to the fall of this quantity of light, and the number per unit area may increase, and it is made as [ equalize / the outgoing radiation quantity of light of the lighting light by which outgoing radiation is carried out by this than outgoing radiation side 12C ]. In addition, in the form of this operation, a light-scattering pattern is irregularly arranged about the direction which met plane-of-incidence 12A near the plane-of-incidence 12A further, so that the number per unit area may increase gradually toward the corner of outgoing radiation side 12C between the point light sources 7 so that the number per unit area may increase gradually toward a wedge-action-die nose of cam from the plane-of-incidence 12A side. In addition, light-scattering patterns may be other configurations, such as not only a circular configuration but a rectangle configuration. Moreover, also by changing the grade of granularity and split-face-izing the whole surface of rear-face 12B, the outgoing radiation quantity of light of the lighting light by which outgoing radiation is carried out from outgoing radiation side 12C can also be equalized.

[0028] Thus, the light guide plate 12 which carries out outgoing radiation of the lighting light is made as [ form / repeatedly / slot 12D of the same configuration / in plane-of-incidence 12A ] so that it may expand partially with Arrow C and may be shown. Such slot 12D is formed in the point light source 7 and the part which counters here so that it may extend in the thickness direction of plane-of-incidence 12A.

[0029] Thereby, furthermore, slot 12D connects the slant face by on pair of flat surfaces which inclined aslant to plane-of-incidence 12A as a cross section was taken according to a field parallel to outgoing radiation side 12C and it was shown in drawing 2 , and is formed, and a light guide plate 12 amends the directivity of the lighting light L by which concentrates in the direction of a transverse plane of the point light source 7, and outgoing radiation is carried out, and it carries out incidence of the lighting light so that it may spread about this field inboard.

[0030] Furthermore, it carve's gradually and the lump depth becomes shallow as outgoing radiation side 12C is approached from rear-face 12B, and slot 12D is formed so that it may stop near the outgoing radiation side 12C. In the form of this operation, slot 12D is formed here so that it may carve in monotone and the lump depth may fall as outgoing radiation side 12C is approached. As drawing 1 is cut off by D-D line by this and it is shown in drawing 3 , a light guide plate 12 interrupts the lighting light by which outgoing radiation is carried out from the point light source 7 towards the outgoing radiation side 12C side by plane-of-incidence 12A, and the point of the point light source 7 which is the point light source emitting light is made not to be viewed from the outgoing radiation side 12C side.

[0031] As for the prism sheet 13, the prism side which is an optical controlling surface is formed in the field by the side of reverse, as for outgoing radiation side 12C of a light guide plate 12. From the plane-of-incidence 12A side, the salient by one pair of slant faces where a prism side extends to parallel mostly with plane-of-incidence 12A of a light guide plate 12 is repeated toward a wedge-action-die nose of cam, is formed, and amends the directivity of the lighting light by which outgoing radiation is carried out from a light guide plate 12 in one pair of these slant faces in the direction of a transverse plane of outgoing radiation side 12C here.

[0032] With outgoing radiation side 12C of a light guide plate 12, the continuing prism sheet 14 is repeatedly formed in the field by the side of reverse so that the same salient as the prism sheet 13 may extend in the extended direction of a salient of the prism sheet 13, and the direction which intersects perpendicularly mostly. Thereby, the prism sheet 14 emphasizes and injects the directivity of the lighting light by which outgoing radiation is carried out in the direction of a transverse plane of outgoing radiation side 12C from the prism sheet 13.

[0033] (2) In the composition more than operation of the form of operation, the lighting light injected from the point light source 7 spreads the interior of a light guide plate 12, while incidence is carried out to the interior of a light guide plate 12 and this lighting light repeats reflection between rear-face 12B and outgoing radiation side 12C from ( drawing 1 ) and plane-of-incidence 12A. At this time [ C / outgoing radiation side 12], whenever it reflects this lighting light by rear-face 12B, the incident angle to outgoing radiation side 12C falls, and outgoing radiation of the component which carries out incidence below with a critical angle to outgoing radiation side 12C is carried out. Moreover, lighting light is urged to outgoing radiation in the portion into which the outgoing radiation quantity of light decreases, when reflecting by rear-face 12B, and it is scattered about with the optical diffusion pattern formed in this rear-face 12B and rear-face 12B is created according to a flat field as a result, and outgoing radiation is carried out by almost uniform quantity of light distribution from outgoing radiation side 12C.

[0034] Thus, in carrying out incidence of the lighting light to a light guide plate 12 from the point light source 7, when outgoing radiation is carried out by sharp directivity towards ( drawing 2 ) and the direction of a transverse plane of the point light source 7, the lighting light by which outgoing radiation is carried out from the point light source 7 In having created the part plane-of-incidence 12A according to the flat field, the outgoing radiation quantity of light falls in the plane-of-incidence side corner of outgoing radiation side 12C between the point light sources 7 near the plane-of-incidence 12A, and brightness nonuniformity is observed.

[0035] On the other hand, in the form of this operation, in slot 12D formed in plane-of-incidence 12A, an optical path is bent by the slant face, respectively and the lighting light L which carries out incidenc to the slant face which forms this slot 12D can distribute to the both-sides side of a light guide plate 12 ( drawing 2 ). Thereby, with a light guide plate 12, between the point light sources 7, the quantity of light of the lighting light L which runs short in a plane-of-incidence side corner is compensated, and th brightness nonuniformity of outgoing radiation light is reduced.

[0036] The lighting light which carries out outgoing radiation from the point light source 7 when slot 12D carved gradually as ( drawing 3 ) outgoing radiation side 12C was approached with the light guide plate

12 in having done still in this way and distributing the lighting light L, the lump depth became shallow and slot 12D has stopped near the outgoing radiation side 12C, and goes to the outgoing radiation side 12C sid is interrupted by plane-of-incidence 12A. It can avoid viewing the point of the point light source emitting light from an outgoing radiation side side by this, and a display image high-definition as the part liquid crystal display can be formed.

[0037] (3) According to the composition beyond th effect of the form of operation, to the part which counters the point light source 7 of a light guide plate 12 at least Form two or more slot 12D extended in the thickness direction, and it sets near the outgoing radiation side 12C at least. by [ by which this slot 12D carves and the lump depth approaches outgoing radiation side 12C ] it being alike, and following and making it become shallow gradually, as the point of the point light source 7 emitting light cannot be viewed from the outgoing radiation side 12C side, the brightness nonuniformity near the plane-of-incidence 12A can be reduced

[0038] Therefore, in side light type surface light source equipment 11, it can use for the lighting of a liquid crystal display panel etc., without devising processing of shading etc. to the outgoing radiation side of a light guide plate in any way near the plane-of-incidence 12A, and an outgoing radiation side can be effectively used also near [ the ] the part plane of incidence. Moreover, as a liquid crystal display, a liquid crystal display can be constituted also near the plane of incidence of surface light source equipment, using an outgoing radiation side effectively, and a high-definition display image can be displayed.

[0039] (4) it is the form of other operations -- in the form of above-mentioned operation, although th case approaching outgoing radiation side 12C where it is alike, and followed, carved in monotone, and the lump depth was made shallow was described It can be carved gradually, can make the lump depth shallow, and can acquire the same effect as the form of above-mentioned operation as it approaches an outgoing radiation side in short, when carving functionally the 2nd order and making the lump depth shallow as are shown not only in this but in drawing 4 , and this invention approaches an outgoing radiation side.

[0040] Moreover, although the case where a slot was formed was described so that it might carve most by the rear-face side and the lump depth might become deep in the form of above-mentioned operation As shown not only in this but in drawing 5 , in short, this invention is set near the outgoing radiation side at least, when [ of plane-of-incidence 12A ] forming so that the depth of flute may become the deepest in the center mostly. A slot can be formed and the same effect as the form of above-mentioned operation can be acquired so that it may carve gradually and the lump depth may become shallow as an outgoing radiation side is approached.

[0041] Moreover, in the form of above-mentioned operation, although the case where a slot was formed only about the point light source and the part which counters was described, as long as this invention forms a slot not only in this but in the point light source and the part which counters, it can acquire the same effect as the form of above-mentioned operation, for example, in short, may form a slot all over plane of incidence at least.

[0042] Moreover, in the form of above-mentioned operation, although the case where connected the slant face by one pair of flat surfaces which inclined aslant to plane-of-incidence 12A, and a slot was formed was described, this invention may form a slot not only by this but by the curved surface. In addition, not only when transposing the slant face of the slot which only starts the form of above-mentioned operation in forming a slot by the curved surface to a curved surfac , but when forming so that the cross section of plane of incidence may change with sinusoidal configurations when a cross section is taken according to a field parallel to an outgoing radiation side and it sees for example, it thinks.

[0043] Moreover, in the form of above-mentioned operation, although the case where a slot was only formed in plane of incidence was described, this invention is good also considering the plane of incidence which formed the slot by split-face-ized processing not only by this but for example, mat side processing, adhesion of ink, etc. as the optical diffusing surface. If it does in this way, lighting light can be efficiently distributed to a both-sides side further much more.

[0044] Furthermore, although the case where the point light source by which the semiconductor chip was closed by the resin package of a rectangle configuration in the form of above-mentioned operation was used was described, this invention can be widely applied, when using the point light source of not only this but various configurations. In addition, as these point light sources, without closing in a resin package, there are some which are constituted by mounting a semiconductor chip in a direct substrate front face, and a semiconductor chip may be covered with a protective coating etc. if needed in this case.

[0045] Furthermore, with the form of above-mentioned operation, although the case where incidence of the lighting light was carried out from an end side was described, this invention is widely applicable not only to this but the side light type surface light source equipment of composition of carrying out incidence of the lighting light from other end faces collectively.

[0046] Furthermore, with the form of above-mentioned operation, although the case where this invention was applied to the side light type surface light source equipment using the light guide plate which becomes by the plate-like part material of a cross-section wedge-action-die configuration was described, this invention is widely applicable not only to this but the side light type surface light source equipment which used the light guide plate of a monotonous configuration.

[0047] Moreover, although the form of above-mentioned operation described the case where carried out the laminating of the prism sheet to the outgoing radiation side of a light guide plate, and it was arranged to it, if this invention can especially be applied widely and does not have the need when arranging the optical diffusion sheet which diffuses not only this but lighting light, and arranging various web materials, these web materials are also omissible.

[0048] Furthermore, with the form of above-mentioned operation, although the case where this invention was applied to the surface light source equipment of a liquid crystal display was described, this invention is widely applicable to the light guide plate of side light type surface light source equipments, such as not only this but various lighting devices, display, etc., and also this side light type surface light source equipment.

[0049] [Effect of the Invention]
as the point emitting [ of the point light source ] light cannot be viewed from an outgoing radiation side side by [ by which this slot carves / near the outgoing radiation side / at least / form two or more slots extended in the thickness direction to the part which counters the point light source of a light guide plate at least according to this invention as mentioned above, and ], and the lump depth approaches an outgoing radiation side / it being alike, following and making it become gradually shallow, the brightness nonuniformity near the plane of incidence can be reduced

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## DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]
[Drawing 1] It is the decomposition perspective diagram showing the side light type surface light source equipment concerning the gestalt of operation of this invention.
[Drawing 2] It is the cross section with which explanation of operation of the slot in the light guide plate of drawing 1 is presented.
[Drawing 3] It is the cross section in which cutting off drawing 1 by D-D line, and showing it.
[Drawing 4] It is the cross section showing the light guide plate applied to the gestalt of other operations by contrast with drawing 3 .

[Drawing 5] It is the cross section showing the light guide plate which formed the slot by contrast with drawing 3 so that it might become the deepest at a part for th center section of plane of incidence.
[Drawing 6] It is the decomposition perspective diagram showing conventional side light type surface light source equipment.
[Drawing 7] It is the cross section in which cutting off drawing 6 by the A-A line, and showing it.

[Description of Notations]
1 11 [ .. Plane of incidence, 2B, 12B / .. A rear face, 2C, 12C / .. An outgoing radiation side, 3 / .. The primary light source, 4 / .. A reflective sheet, 7 / .. The point light source, 12D / .. Slot ] .... 2 Side light type surface light source equipment, 12 .. A light guide plate, 2A, 12A

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1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

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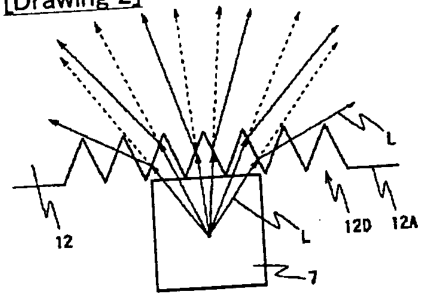
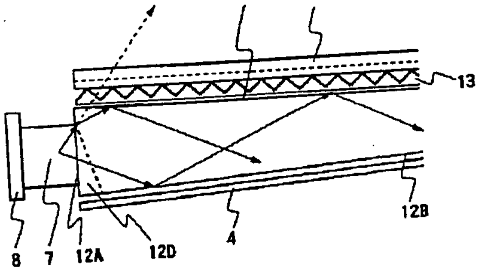
## DRAWINGS

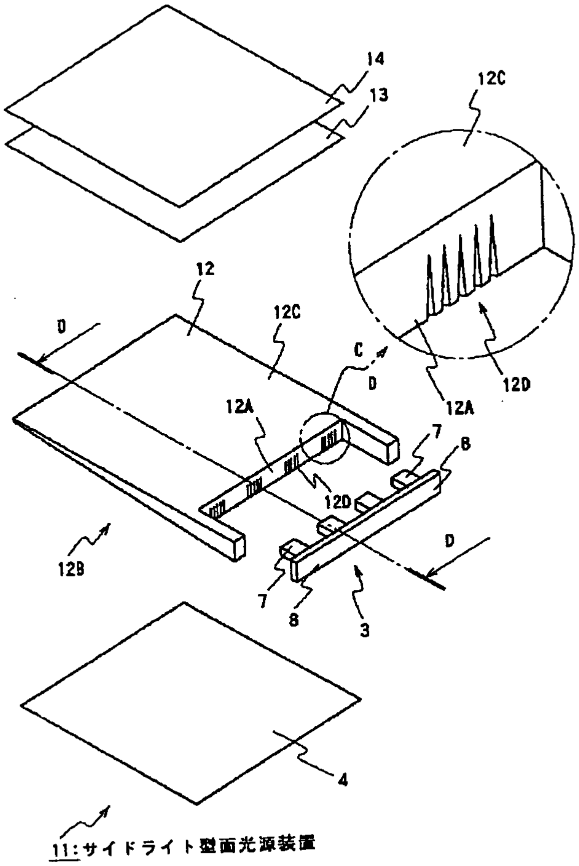
[Drawing 2]



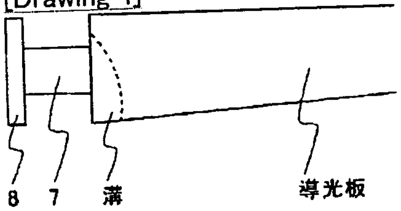
[Drawing 3]



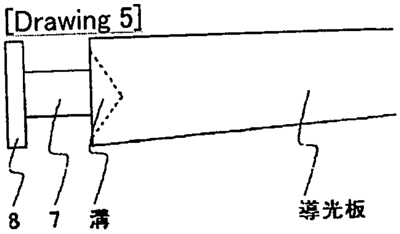
[Drawing 1]



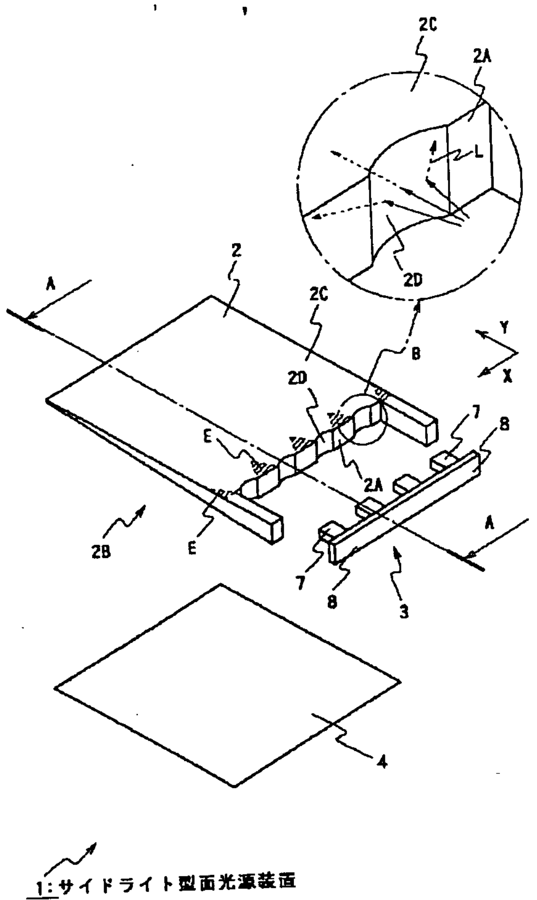
[Drawing 4]



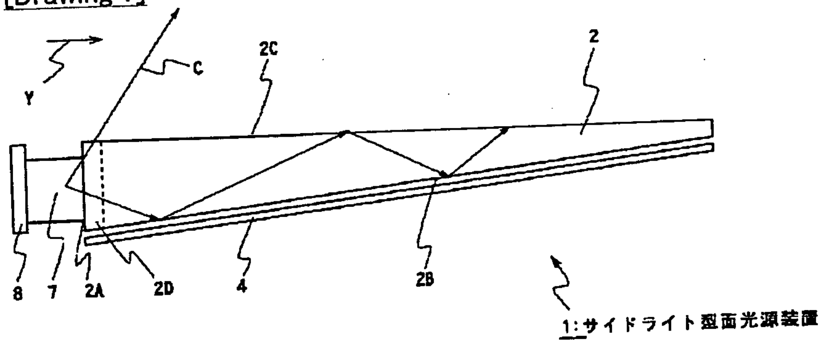
[Drawing 5]



[Drawing 6]



[Drawing 7]



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[Translation done.]